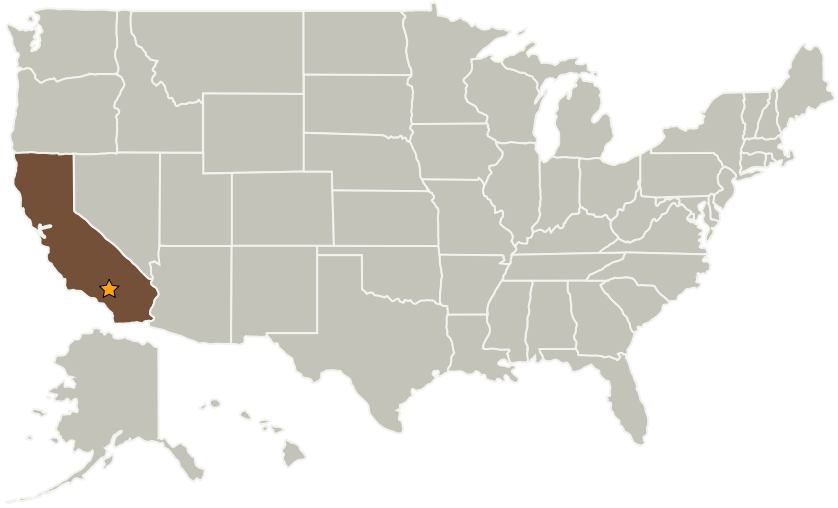
Ceramic Composite Mechanical Fastener System for High-Temperature Structural Assemblies, Phase II

Completed Technology Project (2007 - 2010)

Project Introduction

Under Phase I, the feasibility of a novel thermal stress-free ceramic composite mechanical fastener system suitable for assembly of high-temperature composite structures was successfully demonstrated. The innovative 2-dimensional (2D) fastener design facilitates joining load-bearing hot structural assemblies and can be produced at a cost much lower than other competing designs and methods. Functional SiCf/SiCm composite fasteners having two (2) fiber reinforcement orientations of 0/90-degrees (cross-ply) and ±45-degrees (bias-ply) were fabricated for characterization. Testing of the respective fasteners included both axial tension and single-lap shear. The cross-ply reinforced SiCf/SiCm fasteners exhibited axial tensile and single-lap shear strengths of 38.0 and 33.1 ksi, respectively. The bias-ply fasteners exhibited axial tensile and single-lap shear strengths of 31.3 and 29.8 ksi, respectively. Using a generalized analytical method for determining the distribution of forces and stresses in the 2D mechanical fastener developed in Phase I, optimized configurations will be designed and produced in Phase II for evaluation. The metallic subcomponents used for Phase I demonstration will be produced using a high temperature-capable material (e.g., ceramic, superalloy). Aerodynamically smooth Cf/SiCm and SiCf/SiCm composite structural lap joints will be assembled using the optimized composite fastener system for characterization. Testing of the lap joint assemblies will performed to determine the flexibility and structural efficiency of the joint as a function of off-axis loading relative to the principal axis of the fasteners. Elevated temperature testing will be performed to establish the effects of temperature on the mechanical properties of the joint.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Hyper-Therm High-Temperature Composites	Supporting Organization	Industry	Huntington Beach, California

Primary U.S. Work Locations
California

Project Transitions

December 2007: Project Start

March 2010: Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.3 Thermal Protection Components and Systems
    - TX14.3.1 Thermal Protection Materials